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ABSTRACT

This newsletter contains items of interest to anyone concerned with science and society issues. The first section of this issue contains 25 news and communication items including announcements or descriptions of study opportunities, projects, conferences and programs as well as investigations and research into the social issues of science. The feature article is an essay retrospectively looking at the impact of technological assessment on science and society. The essay examines some of the environmental and technological assessment legislation impact and what has been learned from it, the feasibility of technological assessment, the value of public input into technological assessment, and the impact on and stimulation of innovation by technological assessment. A general bibliography is also included in the newsletter. (MR)

NEWSLETTER ON SCIENCE, TECHNOLOGY & HUMAN VALUES

(Formerly: Newsletter of the Program on Public Conceptions of Science)

October 1976 Number 17

Vivien B. Shelanski

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All correspondence should be addressed to:

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Aiken Computation Laboratory 231

Harvard University

Cambridge, Massachusetts 02138

(617) 495-4496

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A few back copies of earlier issues are still available.

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Editor's Introduction

Thanks to renewed support from the National Science Foundation and the National Endowment for the Humanities, the Newsletter has embarked on its fifth year of publication. Several changes will be apparent to regular readers and other innovations deserve to be pointed out. First, the publication has a new institutional home and is now being produced under the auspices of the Harvard University Program on Science, Technology and Public Policy. Next, it has a new title--Newsletter on Science, Technology & Human Values--a title which reflects its emphasis on the ethical dimensions of science and technology, including the public perceptions of those issues.

Another departure is the immediate initiation of a subscription fee: $6.00 for the four issues of academic year 1976-77. This has been made necessary, in part, by mounting production costs and the growth of the Newsletter audience. In larger part, however, the charge reflects the conviction of our sponsors that the science-technology-values field has become healthy enough to begin to contribute to the support of a professional publication. Your support of this effort will help to ensure the continuation of the Newsletter and will provide an indication of the vitality of the field. To subscribe, simply return the form in the front of this issue, with your check or money order, to the Newsletter office.

A distinguished board of Editorial Advisors has been assembled to provide guidance in shaping the direction of the Newsletter. Its members include specialists in the humanities and social sciences (history, philosophy, literature, political science, sociology, bioethics), as well as the natural sciences (physics, biology) and engineering. Together, these advisors represent the full range of disciplinary concerns which characterize the science-values field.

This issue of the Newsletter has been designated Number 17: this is but one way of acknowledging the direct line between the current publication and the earlier series of Newsletters of the Program on Public Conceptions of Science. Writing in the June 1976 issue (Number 16), Gerald Holton characterized the parent Newsletter as "a sort of central switchboard and matchmaker for the 'invisible college' of producers and users interested in (this) work." The Newsletter on Science, Technology & Human Values will continue to act as a central switchboard and to serve as a mechanism for the sharing of scholarly and resource oriented information which cuts across disciplinary boundaries and contributes to the continued development of research and teaching in this field.

To this end, the "News Items" section will carry brief summaries of actions by government agencies, professional organizations and the like; reports of teaching programs and research in progress; and timely announcements of conferences and fellowship opportunities. Readers are not only invited but urged to submit materials.

Similarly, through the "General Bibliography" section with its annotated listings of recent articles, books and reports, the Newsletter seeks to provide a guide to current resources. Suggestions from readers--of their own and other

publications--will help to broaden the scope of the Bibliography.

In the past, the Newsletter has featured both scholarly articles on significant issues and special bibliographies on particular topics (e.g., "The Law-Science Confrontation"), or the works of a particular country (e.g., the Soviet Union). Continuing that tradition, Section II of this issue consists of an article by Harvey Brooks, "Technology Assessment in Retrospect." Readers are invited to submit manuscripts for consideration. Three copies of the article to be reviewed should be sent to the Editor; the maximum length is 25 pages (double-spaced).

Many developments attest to the surging interest in issues of scientific ethics. To cite but one especially visible example: the social and scientific implications of recombinant DNA research are being scrutinized by scientists, research organizations, government agencies, congressional committees, local governments, and scholars in the humanities and social sciences. (See News Items B, C, F, and G.) In the academic arena, a recent survey by the Cornell University Program in Science, Technology and Society has identified more than 175 formal programs involved in some aspect of science-and-society research and/or teaching. Signs of the increasing professionalization of the field include the formation of specialty groups within existing disciplinary societies, such as the Philosophy and Medicine Committee of the American Philosophical Association. In addition, there is a new organization whose focus encompasses at least a portion of the science-values field: the year-old Society for Social Studies of Science (4S), which has already attracted more than four hundred members.

Our continued ability to serve the needs of this developing field depends heavily on the participation and support of our readers. In past years you have been most generous in sharing information about your activities, research and publications. We will continue to rely on your contributions of news, your suggestions of needs to be filled, and your support of this Newsletter through subscription.

Vivien B. Shelanski

I. NEWS ITEMS AND COMMUNICATIONS

A. NSF Office of Science and Society

An Office of Science and Society (OSS) has been established in the Science Education Directorate of the National Science Foundation. Dr. Alexander J. Morin is Director of the Office. The distinctive task of the programs which comprise the OSS is to facilitate a better understanding of the changing relationship between the scientific and technological communities and the society of which they are part.

The Public Understanding of Science Program, led by George W. Tressel, is directed toward two principal goals:

1) increased public understanding of the nature of science and technology as social and intellectual processes and of their relationship to the society in which these processes take place, and

2) increased public understanding of the scientific and technological components of major issues of current public policy.

The program also has several secondary goals in support of its basic objectives:

3) to improve the scope, level and quality of scientific and technical writing and reporting addressed to the general public;

4) to improve the techniques of distribution and dissemination of scientific and technical information to non-scientists; and

5) to encourage research and analytical studies that lead to greater understanding of the communication process and the public audience.

Revised program guidelines are now in preparation and should be available by the end of 1976. For further information, write to: Public Understanding of Science, Science Education Directorate, National Science Foundation, Washington, D.C. 20550.

William A. Blanpied has been appointed Program Manager for the Ethical and Human Value Implications of Science and Technology Program. The EHVIST program has three principal objectives:

1) increased understanding of the ethical problems and value conflicts generated by scientific and technological developments, as they affect both the scientific community and the larger society;

2) increased understanding of the impact of changing ethical and social standards on the scientific and technological enterprise, including the issues raised in establishing research priorities and in the conduct of research; and

3) increased understanding of those processes of interaction between science and society which generate value conflicts and those which may lead to their resolution.

The program supports research (including analytical and case studies), conferences, workshops and other activities designed to reach these objectives. When appropriate, projects may also be supported in collaboration with the National Endowment for the Humanities and other federal agencies. Revised guidelines, which should be available in early 1977, will specify program priorities for the current year and provide instructions for the preparation and submission of proposals.

For further information, write to: Ethical and Human Value Implications of Science and Technology, Science Education Directorate, National Science Foundation, Washington, D.C. 20550.

Planning for the Science for Citizens Program has been underway for more than a year; its objectives are:

1) to facilitate the participation of scientists and nonscientists in the resolution of public policy issues with significant scientific and technological components;

2) to enable citizens, individually and in their organizations, to identify and to secure scientific and technical information that will enable them to deal more effectively with issues of public policy; and

3) to establish effective dialogues between citizens and scientists, especially at the local and community level, that may lead to increased mutual understanding.

In Fiscal Year 1977, the first year of funding for this program, several experimental means of approaching these objectives will be under consideration, in order to develop appropriate guidelines for the preparation of proposals.

Requests for further information should be addressed to: Science for Citizens, Science Education Directorate, National Science Foundation, Washington, D.C. 20550.

B. Research Controversy in Cambridge, Ma.

Public debate over the safety of recombinant DNA research took a new direction during the summer, when the City Council of Cambridge,

Massachusetts, held hearings and called for a moratorium on recombinant DNA experimentation within Cambridge.

The Cambridge city government became involved in the debate after an announcement by Harvard University that plans were underway to renovate the fourth floor of the biology building to provide containment facilities for moderate-risk genetic experiments, including some involving the new recombinant technique. Cambridge Mayor Alfred E. Vellucci argued that the proposed Harvard laboratory and recombinant DNA experiments could endanger the health of Cambridge citizens and were thus a matter for the City Council's consideration. Vellucci called a special hearing on June 23, 1976, then scheduled an additional session at a regular Council meeting July 7.

Testifying at the crowded hearings, opposing groups of scientists from Harvard, MIT, National Institutes of Health, and other institutions debated the importance of recombinant DNA research, the safety of the proposed laboratory at Harvard, and the adequacy of the newly released (June 23) NIH guidelines. At the July 7 meeting, the Council voted 5-4 in favor of a three-month "good faith" moratorium (the ban lacks legal force) on moderate- and high-risk recombinant DNA experiments in Cambridge. Because the moratorium covered only the higher risk categories, it was not expected to affect Harvard or MIT scientists' current research plans.

The Council also voted to establish a permanent Cambridge Laboratory Experimentation Review Board (CLERB), whose first duty was to study proposed recombinant DNA research at MIT and Harvard and to report its recommendations to the Council before the end of the moratorium. Nine Board members were appointed in early August; all are Cambridge residents, with backgrounds ranging from public health to city politics (no scientists).

While the CLERB was beginning its study, Mayor Vellucci arranged for exhibits on recombinant DNA to be included at his weekly "Mayor's Marketplace '76" summer street fairs, held Saturdays in Kendall Square, Cambridge. On July 17, in addition to the usual food, crafts and entertainment, the fair contained two booths on recombinant DNA, one for representatives from Science for the People opposing the research, and one for scientists from Harvard and MIT favoring the research. The scientists answered questions from passersby, passed out literature and conducted mock experiments to demonstrate laboratory equipment and procedures.

In late September, the Cambridge City Council voted unanimously to extend the moratorium for an additional three months, until January 7, 1977. Both Harvard and MIT have voluntarily agreed to observe the moratorium extension.

Reports of the Cambridge controversy over recombinant DNA research may be found in the following articles:

"Should Genetic Engineering Be Curbed by Public Interest?" New Scientist 71, 1 July 1976: 3.

Chedd, Graham. "Threat to U.S. Genetic Engineering." New Scientist 71, 1 July 1976: 14-15.

"Recombinant DNA Meets the Cambridge City Council." Science News 110, 16 May 1976: 36.

Culliton, Barbara. "Recombinant DNA: Cambridge City Council Votes Moratorium." Science 193, 23 July 1976: 300-301.

"No Vacation for DNA Issue." Science News 110, 7 August 1976: 87, 90.

Historical Documentation of the Recombinant DNA Controversy

Development of concern among scientists and the public about the potential biohazards of research on recombinant DNA is being documented in an oral history/archival project at the Massachusetts Institute of Technology. The project was initiated in the spring of 1975, shortly after the Asilomar Conference, as a quick-response effort to ensure the preservation of unique source materials essential for full understanding of the issues involved. It includes: (1) documentation of ongoing events as they unfold, such as actions taken by governmental agencies, scientific organizations, laboratory administrations, groups of researchers, and local communities in response to the issues; and (2) oral history interviews on the backgrounds, motivations, perceptions and actions of principal participants, including scientists responsible for research advances in the field, individuals involved in the development of guidelines and those who have publicly supported or criticized these efforts, and journalists responsible for covering the recombinant DNA story. Archival documents being collected include reports, memoranda, personal and official correspondence, tapes and press reports from the U.S., Europe and Japan.

The aim of the project is to create a fully catalogued collection of oral history interview transcripts and archival documents, which will be deposited in the MIT Libraries where it will be available for use in research and education. Selected materials from the collection will be included in a documentary history of the recombinant DNA controversy, which will make them more accessible to educators and researchers concerned with the ethical and human values issues involved. This published volume will serve as a guide to the full collection.

Interviews have been conducted with 45 individuals thus far and more than one thousand documents have been collected. The initial deposit of

interview transcripts in the MIT Libraries will be made in October 1976, and subsequent deposits will be made as materials are organized and cataloged. The project is scheduled for completion by summer 1977.

The Recombinant DNA Project is being conducted as part of the new Oral History Program at MIT by Charles Weiner, Professor of History of Science and Technology; Rae Goodell, Postdoctoral Fellow; and Mary Terrall, Research Assistant. It is supported by the MIT Oral History Program and by a joint grant from the National Science Foundation and the National Endowment for the Humanities (Program on Ethical and Human Value Implications of Science and Technology).

For further information, contact Charles Weiner, Technology Studies Program, School of Humanities and Social Science, MIT, R20D-224, Cambridge, Massachusetts 02139; telephone: (617)253-4063.

D. AAAS Establishes Scientific Freedom and Responsibility Committee

The American Association for the Advancement of Science has established a Committee on Scientific Freedom and Responsibility to develop a program concerning the professional rights, ethics and accountability of the scientific community. In issuing the charge for the new committee, which is headed by Dr. H. Bentley Glass, the AAAS Committee on Council Affairs noted that "the increasing interaction among science, technology and the public interest is bound to raise new issues and problems of professional rights, ethics and accountability, and the decision rules which worked in the past may no longer suffice."

Among its activities, the Committee on Scientific Freedom and Responsibility will: work with societies affiliated with the AAAS to adopt policies and procedures designed to protect their members against infringements upon scientific freedom and responsibility; examine documented allegations of infringements of these principles; and, in exceptional circumstances, review cases whose ramifications are thought to be exceptionally significant. The Committee will also keep itself and the Association informed of significant developments and issues (including governmental policies and actions) which call for examination and discussion.

In addition to Dr. Glass, Committee members appointed for two years include: William Bevan, Duke University; John T. Edsall, Harvard University; Harold Green, National Law Center, George Washington University; M. King Hubbert, U.S. Geological Survey; Charles A. Mosher (R-Ohio), U.S. House of Representatives; Jane M. Oppenheimer, Bryn Mawr College; Peter Petkas, Southern Regional Council; Joel Primack, University of California at Santa Cruz; Jeremy Stone, Federation of American Scientists; Jessica Tuchman, staff of Rep. Morris Udall; Frank von Hippel, Center for Environmental Studies, Princeton University; and Dael Wolfle, University of Washington. Rosemary A. Chalk is the AAAS staff officer for the Committee.

The first session of the Committee was held on October 8 and 9, 1976, in a meeting that was open to the public.

For additional details, see: "Scientific Freedom and Responsibility Committee Appointed," Science 193, 3 September 1976: 877, 921.

E. NAS Endorses "Affirmation of Freedom of Inquiry and Expression"

At the annual meeting of the National Academy of Sciences on April 26, 1976, members passed a resolution entitled "An Affirmation of Freedom of Inquiry and Expression." Members of the American Physical Society have been invited to express support of the resolution, for transmittal to the Commission on International Relations of the National Academy of Sciences. The text of the resolution follows:

An Affirmation of Freedom of Inquiry and Expression

I hereby affirm my dedication to the following principles:

...That the search for knowledge and understanding of the physical universe and of the living things that inhabit it should be conducted under conditions of intellectual freedom, without religious, political or ideological restriction.

...That all discoveries and ideas should be disseminated and may be challenged without such restriction.

...That freedom of inquiry and dissemination of ideas require that those so engaged be free to search where their inquiry leads, free to travel and free to publish their findings without political censorship and without fear of retribution in consequence of unpopularity of their conclusions. Those who challenge existing theory must be protected from retaliatory reactions.

...That freedom of inquiry and expression is fostered by personal freedom of those who inquire and challenge, seek and discover.

...That the preservation and extension of personal freedom are dependent on all of us, individually and collectively, supporting and working for application of the principles enunciated in the United Nations Universal Declaration of Human Rights and upholding a universal belief in the worth and dignity of each human being.

The text of the U.N. Universal Declaration of Human Rights is published in the Bulletin of the American Physical Society 21, July/August 1976: 917-918.

F. Science Advisor Appoints Consultants to OSTP

Dr. H. Guyford Stever, Director of the White House Office of Science and Technology Policy (OSTP), has appointed two consultants to the OSTP: Dr. Donald Kennedy, Stanford University, and Dr. William A. Nierenberg, Scripps Institution of Oceanography. Dr. Kennedy, a biologist, will devote his attention to three areas: basic research in agriculture, policies concerning guidelines for recombinant DNA research, and the report and recommendations of the President's Biomedical Research Panel. Dr. Nierenberg, a physicist, will review energy issues and ocean policy.

The areas targeted for attention were selected by two advisory groups established in November 1975 to determine issues to be focused upon by the OSTP. Although the existence of these panels--the Contribution of Technology to Economic Strength Advisory Group, chaired by Dr. Simon Ramo, and the Anticipated Advances in Science and Technology Advisory Group, chaired by Dr. William Baker--has formally terminated, the members will continue to be involved in science advisory functions.

G. Senate Subcommittee Examines Research Policies

The Senate Health Subcommittee, chaired by Sen. Edward Kennedy, has held two in a series of hearings which mark the start of its year-long review of biomedical and behavioral research policies. In announcing the public hearings, Sen. Kennedy stated that "the research community and the public investment in it have reached the point where a careful examination of basic principles is in order."

The subject of the first hearing, on June 16 and 17, 1976, was "Basic Issues in Biomedical and Behavioral Research." Witnesses included members of the President's Biomedical Research Panel, whose study of the nation's biomedical research effort was submitted to the Subcommittee last April.

The second hearing, held on the morning of September 22, 1976, focused on "Recombinant DNA Research and the NIH Guidelines." A substantial portion of the discussion was devoted to the plans of private industry and government research organizations to conform to the NIH guidelines for recombinant experiments. University scientists also debated the potential benefits and risks of this new area of research.

A schedule of further hearings will be available later this fall. Inquiries should be addressed to: Office of Senate Health Subcommittee, Room 310, Senate Courts Building, 120 C St., N.E., Washington, D.C. 20510.

H. Public Participation in Science Policy Development

The National Science Board, the policy-making body of the National Science Foundation, plans to sponsor several regional forums to give individuals an opportunity to express their views on scientific and science education

issues. According to the announcment of the program, "The Board hopes to hear the views of individuals representing a broad section of society, including business, state and local governments, public interest and citizen groups, and academia."

The first Regional Forum was held in Atlanta, Georgia, on June 21, 1976. Four topics were emphasized: natural resources and regional growth, food systems, energy, and education. These issues were selected by a regionally based citizen planning group which met in Atlanta in April, 1976.

Information about the Atlanta meeting may be obtained from Fernbank Science Center, 156 Heaton Park Drive, N.E., Atlanta, Georgia 30307. For other information about the Regional Forums, write to: National Science Board, 1800 G St., N.W., Washington, D.C. 20550.

I. Increasing the Participation of Women in Science

The Women in Science Program of the National Science Foundation has awarded 33 grants as part of "an attempt to tap the underutilized scientific resource which women represent." In announcing the awards, the Foundation stated that the objective of the Women in Science Program "is to develop and test methods to attract and retain women in scientific careers. Although women make up 51 percent of the (U.S.) population, they represent less than ten percent of those currently employed as scientists."

The grants will provide support for 22 Science Career Workshops and eleven Science Career Facilitation Projects. The one- or two-day Workshops, for undergraduate and graduate students, will provide advice about preparation for scientific careers and information about job opportunities in different scientific fields. The Science Career Facilitation Projects are designed for women who received bachelor's or master's degrees in science between two and fifteen years ago and who are not presently employed in the fields for which they are trained. Participants in these projects will be prepared for entry into graduate training or employment.

To receive a list of projects supported, request announcement NSF PR 76-58 (July 2, 1976) from Mr. Nathan Kassack, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550.

J. Scientific Investigation of Claims of the Paranormal

Concern about the growing public interest in psychic phenomena, the occult and pseudoscientific theories has led to the formation of the Committee for the Scientific Investigation of Claims of the Paranormal. The group, made up of scholars, scientists and investigators from a wide variety of disciplines, has as its co-chairmen Professors Paul Kurtz (philosophy, State University of New York at Buffalo) and Marcello Truzzi (sociology, Eastern Michigan University).

According to co-chairman Kurtz (Science News 109, 29 May 1976: 346): "We wish to make it clear that the purpose of the committee is not to reject on a priori grounds, antecedent to inquiry, any or all such claims, but rather to examine them openly, completely, objectively and carefully."

The Committee will establish a network of people interested in examining claims of paranormal phenomena, prepare bibliographies of published materials that examine such claims, encourage and commission research by "objective and impartial" observers in areas where needed, arrange for publications and sponsor meetings and conferences.

The Committee will publish a journal, The Zetetic, edited by co-chairman Truzzi. Correspondence about the journal may be sent to Dr. Marcello Truzzi, Department of Sociology, Eastern Michigan University, Ypsilanti, Michigan 48197.

Membership applications are available from the Committee for the Scientific Investigation of Claims of the Paranormal, 923 Kensington Ave., Buffalo, New York 14215.

See The Humanist (May/June 1976) for a statement of the Committee's purposes. Kendrick Frazier's "Science and the Parascience Cults," (Science News 109, 29 May 1976: 346-348, 350) provides additional details about the Committee: its history, structure and functions. "Science and Pseudoscience: Response," (Science News 109, 19 June 1976: 397-399) is a sample of the responses to the establishment of the Committee.

K. Hastings Center Offers Postdoctoral Fellowships

The Institute of Society, Ethics and the Life Sciences will provide four one-year postdoctoral fellowships for the study of ethics and the life sciences during the academic year 1977-78. Funds have been provided by a grant from the National Endowment for the Humanities. The purpose of the fellowships is to permit researchers to prepare themselves for future research on ethical problems arising from advances in medicine and biology.

Fellowships will be awarded on the basis of four criteria: (1) a distinguished academic and/or professional record; (2) a commitment to scholarly work in the field; (3) the likelihood of considerable benefit from the fellowship year; and (4) the ability of the Institute to make a substantial contribution to the applicant's proposed study program.

Applicants should have an advanced doctoral or professional degree or its equivalent. The final deadline for application is December 1, 1976. Application materials may be obtained by writing to: Post-Doctoral Fellowship Program, Institute of Society, Ethics and the Life Sciences, 360 Broadway, Hastings-on-Hudson, New York 10706.

L. Guide to NSF Science Education Programs, FY 1977

A guide to NSF's education programs for Fiscal Year 1977 is now available. It provides an overall perspective on the Foundation's science education activities as well as a brief description of the individual program elements. It also includes a schedule of program deadlines.

Copies of the "Guide to Science Education Programs, FY1977" are available from: Central Processing Section, National Science Foundation, Washington, D.C. 20550.

M. NEH Announces "Courses By Newspaper" Offering

A "Courses By Newspaper" program has been developed by the University of California under the sponsorship of the National Endowment for the Humanities. Designed to make academic subjects attractive and readily available, the Fall 1976 offering--"Oceans: Our Continuing Frontier"--is being carried by over 250 newspapers and educational institutions. The NEH grant is also being used to plan another course, "Moral Choices in Contemporary Society," to be offered in January 1977.

For further information about the course, "Oceans: Our Continuing Frontier," contact George A. Colburn, Project Director, University of California at San Diego, Q-056, La Jolla, California 92093.

N. Humanities Perspectives on Technology Program

Lehigh University's Humanities Perspectives on Technology program has received a $50,000 follow-up grant from the National Endowment for the Humanities. The Lehigh HPT program, originally established under a five-year grant by NEH in 1972, focuses on the relationship between technological advance and the quality of human existence, and aims to coordinate the contributions of the humanities to this issue with those of the sciences and technologies. The additional funding will be used to support dissemination activities in three major areas: workshops, the establishment of a newsletter and the formulation of related bibliographies.

Those interested in further information about the Humanities Perspectives on Technology program or wishing to be included on a mailing list for the newsletter and forthcoming bibliographies or workshops should contact Stephen H. Cutcliffe, Administrative Assistant, HPT Program, Lehigh University, 530 Maginnes Hall #9, Bethlehem, Pennsylvania 18015.

O. Position Available: Chair in Humanities-Technology

Lehigh University's Humanities Perspectives on Technology program (see above) has submitted the following announcement:

"The College of Arts and Science, Lehigh University, invites nominations of, and applications from, outstanding scholar-professors for its Andrew W. Mellon Distinguished Chair in the Humanities. Through this Chair the University expresses its belief that science and technology are indispensable parts of the inheritance of students whose primary focus is upon humanistic studies. The appointee is expected to play a major role in the College's ongoing undergraduate program in Humanities Perspectives on Technology. Accordingly, nominations and applications will be considered from scholars and professors of humanities, including historians, who focus on the interrelationships between humanities and technology. Lehigh University is an affirmative action/equal opportunity employer."

Submit letters of applicaton or nominations by December 31, 1976 to: Dr. Saul B. Barber, Associate Dean, College of Arts and Science, 222 Maginnes Hall #9, Lehigh University, Bethlehem, Pennsylvania 18015.

P. Science & Technology Studies: University of British Columbia

A Committee on Science & Technology Studies has been created at the University of British Columbia. Membership in the group is open to all those professionally engaged in these studies--conventionally identified as history, philosophy, sociology of science or technology, science and culture studies, science policy studies and so forth. It is open as well to all those interested in such studies. to practitioners of natural, social and human sciences, and their associated "applied sciences" such as medicine and engineering.

The Committee plans to: organize workshops, lecture-series and seminars; act as a coordinating center for science and technology studies; establish a resource center; develop team-taught interdisciplinary courses of study; and serve as a consulting group to units of the University that wish to develop courses in this area.

For details, contact Stephen Straker, Department of History, or Robert Anderson, Faculty of Applied Science, University of British Columbia, Vancouver 8, British Columbia, Canada.

Q. Research in Progress: Values, Decisions and Scientific Experts

Dorothy Nelkin, Program on Science, Technology and Society, Cornell University, has received a grant for a study entitled, "A Critical Analysis of Value Issues Associated with the Role of Scientific Experts in Decision-Making." This project is supported by a joint award from NSF's EHVIST program and its counterpart at the National Endowment for the Humanities, the Science, Technology and Human Values Program.

The research focuses on contemporary manifestations of the classic controversy between democracy and elitism as demands for citizen participation in scientific and technological decisions conflict with the increasing role of technical experts in the policy process. The study will seek to understand the values of concern in technological controversies and the ways in which policy makers incorporate participatory demands.

R. Project: Science Communication to the Public

At the State University of New York at Binghamton, Lawrence Verbit is directing a project designed to provide undergraduate science majors with experience in communicating scientific information to the public. Supported by the National Science Foundation, the project involves the collaboration of several science departments, the English Department and the Educational Communications Department.

Two seven-week courses have been developed for the participants. The first, "Science Reporting in the Mass Media," taught by Professors Verbit (chemistry) and C. Peter Gruber (English and journalism), introduces students to basic journalism applied to science reporting and to the special problems of writing about scientific issues. In the second, "Science Reporting Workshop," students will prepare a feature-length article on a scientific topic of current public concern. Courses will be supplemented through talks by professional science journalists, collaboration with radio and television stations, and summer internships.

Dr. Verbit writes: "The purpose of this program is not to try to make these students into science writers. Most of them will go on to careers in the health and basic sciences. By their experience in science communication we hope to prepare them to take a more effective role in interpreting science and technology to the public."

Details are available from Dr. Lawrence Verbit, Department of Chemistry, State University of New York at Binghamton, Binghamton, New York 13901.

S. Conference: Retrospective Technology Assessment

Carnegie-Mellon University will sponsor a Conference in Retrospective Technology Assessment (RTA) on December 2-4, 1976. The interdisciplinary meeting will focus on the intended and unintended results of technological innovation on the economic, political, social and physical environment in America. Twelve papers will be delivered in four sessions; one on methodologies for RTA, one on technologies and values, and two on case studies. The keynote address will be given by Daniel DeSimone, Deputy Director of the Office of Technology Assessment.

Further information can be obtained from Professor Joel A. Tarr, Program in Technology and Humanities, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213.

T. Competition: "A Store-Front Physics Exhibit"

The Committee on Science Education for the General Public of the American Association of Physics Teachers/American Physical Society announces a "challenge to the physics community to design, build, tryout and evaluate a 'store-front physics exhibit' which will effectively present information about physics to the general public." Three prizes of $200 each will be awarded at the joint AAPT/APS meeting in Chicago, Illinois, February 9-12, 1977.

Details of the competition may be obtained from: Dr. Dean Zollman, AAPT Executive Office, Graduate Physics Building, State University of New York at Stony Brook, Stony Brook, New York 11794. See also: "Science for the General Public: 'A Store-Front Physics Exhibit' Competition," Bulletin of the American Physical Society 21, July/August 1976: 919.

U. Transdisciplinary Studies in Science and Values

The AAAS has announced the publication of Transdisciplinary Studies in Science and Values (William A. Blanpied and Betsy Kwako, eds.), a collection of papers originally prepared for a symposium at the 1976 meeting of the Association. In addition to an Introduction by Dr. Blanpied, the contents include: "The Cultural and Operational Distinctions between Science and Technology," by Melvin Kranzberg; "Some Reflections on Science and Society," by Harry Boardman; "Cultural Distinctions between Eastern and Western Science--Report on an Interdisciplinary Cross-Cultural Research Project," by John M. Koller; "On the Conceptualization and Measurement of Institutional Values: With Special Reference to the Values of Science," by Milton Rokeach; "Human Values and Progress in Medicine: Problems and Opportunities," by Kenneth Schaffner; "The Natural Sciences and the Study of Human Behavior," by Peter Buck; "Freedom and Coercion: Public Interest Science and the Reduction of Societal Options," by Philip L. Bereano; "Imposing Food Science and Technology: The Case of South Asia and North America," by Robert S. Anderson.

Single copies may be obtained, while the supply lasts, from: Ms. Betsy Kwako, Division of Public Sector Programs, American Association for the Advancement of Science, 1776 Massachusetts Ave., N.W., Washington, D.C. 20036.

V. SISCON Publications

Two new teaching units have recently been published by the Science in a Social Context (SISCON) Project in Great Britain: Decisions on Technology, by E. Braun, D. Collingridge, and K. Hinton; and Health Hazards in Industry, edited by C. Clutterbuck and S. Stauder. SISCON texts are designed to provide an overview of a problem area and to serve as a guide to key issues and additional readings.

Units currently in preparation include: "Science and Ethics," "Tech-

nology Assessment," "Scientific Rationality and Theory of Social Crisis," "Science and Rationality," "The Politics of Planning and the Problems of Science Policy," and "Is Science Neutral?"

A catalogue of available units, price lists and ordering information may be obtained from the Project Coordinator, Prof. W.F. Williams, SISCON Project, Room 9/83, Physics/Administration Building, University of Leeds, Leeds LS2 9JT, U.K.

W. Bioethics Digest

The Bioethics Digest is a new monthly publication designed to provide information about current developments, books and articles in the field of bioethics. It will provide summaries of recent literature, author and subject indices, journal source lists and occasional full-length articles. Subscription information is available from: The Bioethics Digest, P.O. Box 6318, 5632 Connecticut Ave., N.W., Washington, D.C. 20015.

X. Periodicals for "Progressive Scientists"

An annotated list entitled "Periodicals that Progressive Scientists Should Know About" is being prepared by the Progressive Technology Company. The September 1976 edition has over two hundred (unannotated) listings. Copies may be obtained, without charge, by sending a self-addressed, stamped legal-size envelope to: Progressive Technology, P.O. Box 20049, Tallahassee, Florida 32304.

Y. NSF Opens Fellowship Competition

In early 1977 the NSF plans to award approximately one hundred National Needs Postdoctoral Fellowships. The announcement states that the Fellowships "are designed to help meet the nation's future scientific manpower needs for dealing with problems of our society." Awards are made in all fields of science, including interdisciplinary-multidisciplinary fields. Awards are not made in clinical, education or business fields; in history or social work; or in studies toward medical, dental, public health, law, or for joint Ph.D.-professional degrees.

The application deadline is December 6, 1976. For copies of the announcement and application materials, contact the Fellowship Office, National Research Council, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

II. TECHNOLOGY ASSESSMENT IN RETROSPECT

By Harvey Brooks
Benjamin Peirce Professor of Technology and Public Policy
Harvard University

Introduction

Since about 1966 there has been a rapid growth of public, political and scholarly interest in the secondary consequences of technological progress and the applications of technology. This has been accompanied by a rapid proliferation of new legislation to regulate technology and to create new bureaucracies to refine and enforce the regulations, following the dynamics of what J. Q. Wilson has labelled "majoritarian politics," i.e., policy initiatives engineered by "policy entrepreneurs" rather than by client groups, but which usually result in the creation of new client groups that become the constituency of the new bureaucracy and watchdogs over its performance in accordance with the goals of the original entrepreneurs.[1]

There has been a parallel growth of the environmental movement and the technology assessment movement as expressions of this new political perception. Although parallel in purpose the movements have developed rather separately, with different bureaucracies, and distinct client groups and operating philosophies. Of the two, environmental assessment came first, and has been politically more influential, with a larger social impact. Yet the technology assessment and environmental movements cannot be treated entirely separately; they are too closely related, and any assessment of technology assessment in retrospect will have to consider both environmental and technological aspects.

The Magna Carta of the environmental movement was NEPA, the National Environmental Policy Act of 1969, and particularly Section 102, which required environmental impact statements for "all federal actions significantly affecting the environment."[2] The corresponding charter for technology assessment was the Technology Assessment Act of 1972, which created the Office of Technology Assessment in the Congress.[3] But both environmental and technology assessment have been in effect the subject of hundreds of pieces of legislation too numerous to list. One has only to mention auto safety, consumer product safety, pesticide regulation, the clean air amendments, the water pollution control act, the occupational health and safety act, the creation of the Nuclear Regulatory Agency, and so on down the line. All of these pieces of legislation require what amounts to more or less elaborate technology assessments prior to any positive action to permit the application of technology, either in general or with respect to a specific project, such as a dam or a nuclear power plant, or even a specific regulatory action.

It is difficult to distinguish between environmental and technology assessment substantively, since on the one hand the environment has tended to be

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This article is based on the address delivered as the Kayan Lecture at Columbia University, New York, New York, on 29 October 1975.

interpreted more and more broadly to include personal health and safety, depletion of resources and even social effects, while on the other, it is impossible to carry out an assessment of a particular technology without thorough consideration of environmental effects. A true technology assessment may in fact require the comparative environmental assessment of several alternate technologies designed for similar purposes, e.g., coal fired vs. nuclear power plants.[4] One distinction is that environmental and technology assessment have appealed to different professional and political constituencies. By and large, environmental concerns and regulation have become the province of lawyers and biologists (biomedical with respect to public health aspects, or ecological with respect to the natural environment). In contrast, technology assessment (TA) has become the province primarily of engineers and economists. As a result TA is somewhat more positive in its stance towards technology, especially new technology. Whereas environmentalists are concerned almost exclusively with the control of technology and with its possible negative consequences or "externalities," the TA constituency is also concerned with the benefits of technology and with the identification of new or underdeveloped technologies, which might have social benefits or positive "externalities" not wholly realizable within the incentive structure of the private market. In fact the TA Act of 1972 refers explicitly to the potential benefits of neglected technologies.

All this has resulted in an enormous shift in the burden of proof with respect to the introduction of new technology or the expansion of the application of old technology. Whereas the burden of proof used to be on those advocating the slowdown or halting of particular technological developments or applications, it is now on those seeking to advance technological innovations or particular projects. This is due in part to legislation which gives sweeping new powers to new regulatory bureaucracies such as EPA or the Consumer Product Safety Commission or the Occupational Health and Safety Administration. But also, encouraged by legislation, public interest groups have acquired new standing to sue in the courts for the halting of certain kinds of technological developments or projects. Furthermore, the courts have interpreted such legislative mandates as exist in the broadest possible terms, for example requiring no degradation of air quality in regions where the quality is already much higher than legislated ambient standards. Thus many interest groups have been given legal standing to use the judicial process to slow down or halt new developments or new technologies.

The concept of liability has been extended by judicial interpretation so as to embrace "strict liability," i.e., the notion that the manufacturer is liable for injury caused by his product or activity even in the absence of a showing of negligence on his part.[5] Moreover, this concept of liability has been extended well back along the chain of suppliers, like the house that Jack built.

The interpretation of Section 102 of NEPA by the courts has also made it necessary to prepare a full environmental or technological assessment for a technology even to obtain authorization to build a prototype for test or demonstration purposes. For example, it has been difficult to obtain a variance for emission standards for an experimental coal gasification plant, even though such standards would only be relevant when that particular type of plant was deployed commercially on a large scale. Permission for construction of a demonstration plant for the fast breeder required an environmental impact analysis for a full nuclear energy economy based on breeders.

Lessons from Recent History

What, then, can we say about what we have learned? I would like to discuss this under several headings, which I will now summarize.

1) Is technology or environmental assessment really technically feasible, and under what conditions? Can we foresee the consequences of technology sufficiently well to make rational decisions which will not be overtaken by subsequent events? Can we forestall or modify adverse consequences by foreseeing them? Here we must look at both the technical feasibility of TA and the political feasibility of implementing its conclusions.

2) What is the appropriate role of the public in TA? Is so-called "participatory technology" workable in practice? What are the ultimate implications of public participation and of the growing strength of political groups which claim to act as surrogates for the public interest?

3) What standards of evidence and proof should be required in TA? Is it possible to define "reasonable" standards of proof such that the burden of proof placed on one side or the other of a controversy is not totally unrealistic? Can opposing sides be induced to accept the same criteria for the acceptability of technical evidence? What is the appropriate role of scientists and engineers relative to other interest groups and the general public in the technology assessment process?

4) What is the impact, actual and potential, of TA on the process of technological innovation, both in the private and public sectors? What is the impact on economic growth and on the net growth of individual and social welfare, taking into account "externalities" as well as direct benefits? Are the secondary and unforeseen consequences of TA and of the regulation of technology tending to price technological innovation risks out of the market and thus to deprive the public of benefits which might outweigh the benefits of the protection they receive from the regulations? What about the synergistic interactions between different and separate regulatory actions?

5) Conversely, to what extent can it be said that TA and regulation are actually stimulating innovation in new and socially beneficial directions which are more important than the perhaps minor product improvements to which much industrial and public innovative activity was previously directed? For example, are not emission controls of greater social benefit than riding comfort or automatic window controls?

6) Will regulation and TA ultimately become captive to the technological momentum of the area being regulated and to the institutions and professions that advocate or promote the technologies in question? If so, to what extent is this necessarily bad for society?

7) What has been the effect of TA and its attendant processes on the health of science as distinct from technology? What will be its long range impact on the demand for scientists, what scientists do, and the status and role of scientific institutions?

Feasibility of TA

About a year ago, Peter Drucker,[6] in one of his usually provocative articles, ridiculed the whole notion of technological assessment, pointing out that it was impossible to foresee the consequences of technology and that, in fact, the whole TA movement was nothing but a manifestation of scientific hubris--a new intellectual promotion of a piece with other fads such as systems analysis or space exploration. At the same time a number of political scientists took up the cudgels on the opposite side, with the view that TA was just a palliative to avoid more fundamental criticism of the basic assumptions underlying our technological society and the cult of technological progress. Neither critic touched much on the realities of TA as it might be carried out in practice--who will do it, how it will be financed, how and when the general public will have an input, in what form the conclusions will be presented and how the results will be implemented by various institutional decision makers.

Ideally the concept of TA is that it should forecast, at least on a probabilistic basis, the full spectrum of possible consequences of technological advance, leaving to the political process the actual choice among the alternative policies in the light of the best available knowledge of their likely consequences. Such an idealization implies the possibility of a greater separation of value judgments and technical judgments than many people with practical experience in TA would consider feasible. Nevertheless, by a process of iteration or dialogue involving experts and decision-makers (including the public), the ideal might be approached by successive approximations. In this respect the situation would be no different from other political processes, for which there are large differences between the ideal prescription and reality. Such discrepancies are not necessarily an argument for abandoning the ideal.

A more fundamental difficulty is that the evidence to conduct a confident assessment is seldom available at the time when important decisions may have to be taken in view of the pressures emanating from the political process or the sequential nature of important decisions. TA really has to be an iterative learning process, with the first assessment often doing little more than identifying areas where more research is needed. But in many cases definitive research results cannot be available before some decision has to be made. Changing the course of a development, or changing regulations after a technology is partly deployed, can be costly and disruptive, and the unpredictability and risk which it introduces from the standpoint of the developer may be a strong deterrent to enterprising action. This can be very cogently illustrated in the case of the current situation regarding off-shore oil development in the Atlantic. Much of the statutorially authorized decision process is predicated on the assumption that a complete assessment both of resources and of environmental impacts can be made prior to a lease sale. Yet some environmental "baseline" data may take six to eight years to gather. At present a decision to exploit theoretically cannot be reversed once the lease sale is made, even though new information becomes available. A rational decision process has to be spread out in time, with a series of "milestones" or decision points at which changes can be made in the light of new knowledge. Yet this introduces extra risk when decisions are public and the investments are private and the investor has no insurance against the impact of new information.

In the end, I think the question can only be answered by saying some knowledge is better than none. It is better to proceed with incomplete or inadequate

information than with none and some risks will have to be taken. It is the "no risk" assumption sometimes underlying implementation of TA rather than the TA process itself that is at fault. Too much regulation is predicated on an assumption of technological determinism, i.e., that anything that is researched or developed will eventually be deployed. This is not true historically and the TA process cannot realistically be based on such an assumption. Where high risks are involved to the innovator, some sort of insurance may be desirable and necessary to that the psychological and financial pressures resulting from sunk costs will not distort the decision process, either through the suppression of adverse information or through failure to begin a project because of technical uncertainties that can only be resolved by practical experience.

The record on implementation of TA has not been particularly happy. The outcome, whether negative or positive, tends to be more determined by political momentum and bureaucratic balance of power than by a rational process. Despite the implausibility of the assumption of complete technological determinism, it has frequently been difficult for rational analysis to change a technological trend whose directions have been well established. The SST development continued despite many unfavorable TA's and then was cancelled for reasons which were extremely shaky--at least at the time the decision was made by Congress, although subsequent research did confirm what was only a speculative suspicion. The history of auto emission legislation is explained better by political dynamics than by a rational evolution of choices based on improved technology assessments. But perhaps there is some convergence when viewed in a larger perspective. Given the fact that the acquisition of new scientific knowledge is itself a disorderly and halting process, scientists should perhaps allow the political process equal margin for learning by trial and error.[7]

Public Input

This is one of the most controversial questions, and one on which I tend to be more conservative than is currently fashionable. Clearly we are passing through a phase of severe reaction against a purely technocratic mode of decision-making exemplified by the career of Robert Moses of the Port of New York Authority,[8] in which he rode rough-shod over the views of local communities in the interests of a bold technological vision (although this vision was probably one that was supported by the majority of New York State voters as an abstract proposition). At the same time I doubt if it is possible to have wide public participation in every technological decision without a virtual paralysis of all decision-making, and without the complete disappearance of any coherent plan or vision of the future. The problem of public participation is that unless there are some incentives for consensus on an overall strategy embracing more than the particular decision in question, a few people who believe themselves adversely affected or whose values are offended can often dominate the decision process as against more diffuse benefitted interests. In the past, of course, the reverse was often true, and it was economic interests that tended to dominate the decision process in this way; today it is more likely to be political groups claiming to represent the public interest, though often having their own axes to grind. It is one thing to give affected interests an adequate hearing, but quite another to allow particular interests a de facto veto of the ability to ride rough-shod over other interests. In the Jamaica Bay study of the National Academy of Sciences[9] it was pointed out that some thirteen different agencies had the power to impose an absolute veto on the extension of the runways at Kennedy Airport, regardless of any overall assessment of

the public merits. The problem may be less serious when it comes to the assessment of a generic technology, such as the fast breeder program, than in the case of specific projects where the selection of a particular reactor site is in question. In the latter case the adversely affected interests are much more concentrated and hence easy to mobilize, though in a minority compared with those who might ultimately benefit. Nevertheless, unless there is a forum where all interests can be finally balanced and a decision reached, public participation may be merely a prescription for paralysis. It is interesting to note that Congress finally intervened to waive the application of NEPA in the case of the Alaska pipeline after litigation threatened to delay a decision indefinitely in the face of the energy crisis.

There probably needs to be priority with respect to what problems require public participation and what the nature and process of this participation should be. There is no assurance that the interests and viewpoints actually represented in the participation process will include all those that should be represented. The process as presently practiced, for example in the California debate on Proposition 15,[10] appears to encourage polarization at the extremes, with the most radical and sensational positions at either end of the spectrum of opinion getting the most attention. In the California case predictions of imminent radiation disasters tended to be opposed by predictions of imminent collapse of the California economy. The politically active public interest groups or the affected industrial interests are not necessarily the best sampling of the public interest, which is itself rather poorly defined. More importantly, public participation as it has been practiced in the last decade has been very costly in terms of time and money; in the jargon of economists, the "transaction costs" have been very high. The only "success stories" have been those in which technological developments have been stopped by a public process where they might have gone forward in its absence. Thus, in practice, public participation appears to be primarily a strategy for stopping technology, a suspicion which is confirmed by reference to the Nader handbook. I can think of no instance in which an important generic technology or even a specific technological project has been advanced by a participatory process. Perhaps solar power will prove to be such an example, but that can only be judged in the future.

Experience with public participation is very recent. Thus participatory technological decision-making is still subject to considerable social learning. It may be premature to write it off as counterproductive, as I am sure many scientists and technologists who have been involved in the process are inclined to do. Certainly if a process evolves which is not too costly in time and money, it has a high positive value in legitimizing public decisions about technology and insuring better public understanding and acceptance once a consensus is reached. The negative side of this is that if a decision outcome is thought to be the result of manipulation by a minority with a special interest or a special viewpoint, it will not long remain legitimate in the eyes of the public. Popular referenda on technological questions, a tactic followed by opponents in the case of fluoridation and of nuclear power, is a form of participation which is especially prone to manipulation by extremists and by public relations gimmicks. I predict that the public will once again return to decision by experts if it comes to feel that the participatory processes are being used not to better define the public interest, but rather to further special interests or political ideologies out of the mainstream. The benefits in better decisions must be seen over the long run to outweigh the costs of a lengthy and uncertain process.

On balance, then, it is my opinion that public participation has so far been the least satisfactory aspect of TA and that unless a more rapidly convergent process can be devised, the political process will either reject participatory decision-making or will show symptoms of political frustration such as recourse to demagogues or a search for scapegoats.

Standards of Proof

Most of the battles between the proponents and critics of particular technologies boil down to disagreement over what standard of evidence or argument is to be applied. At least this is true when the disagreements appear to be technical rather than explicitly involving a strong difference in ethical or political values. Battles over nuclear power safety and waste disposal, the controversy regarding auto emission standards, most controversies over dam siting or highway impact, etc. are perceived by the public as technical, even though value preferences may be embedded in the outcomes.

For example, in cases of safety the critics demand a high level of proof that a product or activity is safe, while the proponents want proof that the product is unsafe before any action against it is taken. This may be true even when the two sides agree on the definition of acceptable safety. For example, both sides of the controversy on the safety of light water reactors (LWR) would probably agree that the accident possibilities computed in the Rasmussen report are acceptably low. They differ in the confidence level they demand of the computation methods and their experimental verification. The critics say the reactors have not been proved safe because there are gaps in the reasoning regarding the chain of events leading to a possible acoident, while the proponents point to the extreme conservatism of most of the assumptions used in the calculations.

In the controversy over the effects of freon on stratospheric ozone, the manufacturers dismissed the work of the scientists as "abstract speculation" with inadequate observation and experiment to make a case for regulatory action. Many environmentalists, on the other hand, were prepared to ban freon production, regardless of economic consequences, on the basis of evidence which was suggestive of deleterious effects, but far from certain. In the hearings before Congressional committees there was virtually no confrontation of opposing technical arguments; the battle was all over the implications of degrees of confidence in the calculations.

In the reactor example the critics did not propose different accident probabilities on the basis of alternative calculations or models, while in the freon case the manufacturers were not able to propose any specific reason why the scientists' model was likely to be wrong.

It is interesting to note that in the case of one new technology, stack gas scrubbers, the shoe was on the other foot. Here the environmentalists were willing to accept the feasibility and reliability of scrubbers on the basis of technical plausibility and pilot plant data with little operating experience or other evidence regarding performance under full-scale field conditions. The utilities, on the other hand, were demanding a very high standard of proof of the reliability of scrubbers as a condition for acceding to EPA's requirements for scrubber installations. Here there was little disagreement over the specific evidence, only in the conclusions to be drawn from it.

Consensus between critics and proponents might be helped if the two sides could agree on acceptable standards of proof prior to collection of the evidence. This might be possible in a sufficiently well-ordered participatory process, analogous to stipulation in judicial proceedings, especially if guided by experts trusted by both sides. The problem is to secure consensus on standards of proof before the issue becomes heavily polarized by political advocacy. In many controversies it would be interesting to challenge each side to state beforehand what kind of evidence and argument it would need to induce it to reverse or alter its initial position. For example, what would it take to convince nuclear critics that LWR's were acceptably safe? What would it take to convince nuclear advocates that the reactors were unsafe?

It would also be helpful to force the adversaries in a technical or quasi-technical controversy to be explicit about the value assumptions and judgment criteria underlying their conclusions. It would also be helpful to force them to be clearer in their estimates of uncertainties and the scientific confidence with which their conclusions can be affirmed.

Impact on Innovation

When the NAS committee wrote its report, Technology: Processes of Assessment and Choice in 1967, a report which in some ways launched the TA movement,[11] one member wrote an appendix expressing reservations about the possible adverse impact of TA on technological progress and innovation. He pointed to the sensitivity of the innovation process to small changes in the perception of entrepreneurial risk.

What has been the impact of TA, consumerism and environmentalism on technological progress? The question is hard to answer because of so many other environmental factors that have changed--inflation, recession, shortages of capital, radical increases in energy and material costs, and uncertainties about future prices. It is difficult to point to any major innovation that has failed primarily because of TA. The SST was close to being abandoned by its potential clients, the airlines, and would probably have died without assistance from the skin cancer scare, although it is true that the adverse economic assessment by the airlines was largely the result of the banning of overland flights because of the sonic boom. LWR's have been delayed, and their capital costs have far exceeded estimates, largely owing to regulatory delays and increasing regulatory conservatism under pressure from public interest groups. But there is not yet a nuclear moratorium. It is possible that the gas-cooled reactor program may be abandoned because of financial pressures, some of them the indirect result of regulatory events, but the dominant factor in this case is capital shortage and reduction in electricity-demand projections, as well as the erratic behavior of electricity demand in the last two years. Plans for synthetic oil and gas investments have been postponed partly because of uncertainties about environmental standards, but probably more because of uncertainties about future oil prices and government policy towards oil imports and price controls.

Environmental regulations have impacted small businesses and older, marginal manufacturing facilities much more than they have the leaders of an industry who are usually the innovators.

There have been some studies to show that the U.S. has lagged behind other countries in drug innovation and that this was the result of the complexity and

cost of procedures required for FDA approval,[12] but there are other studies which raise doubts about this conclusion.[13] So the matter must still be considered as moot.

During the last 15 years the comparative U.S. position in high-technology internationally-traded capital goods has slipped, but this trend began before environmental assessments could have been an important factor. If the U.S.' standards and the rigor of its assessments continue, there may be a future effect on international trade, but as indicated in the next section, this effect could just as likely prove positive as negative.

Talks with industrial research leaders reveal many plans for retrenchment in research and development in industry, and a growing tendency to concentrate on short-term evolutionary product improvements, with abandonment of projects aimed at more fundamental innovations and brand new technologies. Again, however, it is hard to correlate this with external technology assessments or with the fear of regulation or environmental controls. There has been some trend towards migration of industries with high emissions or hazardous processes out of this country in order to avoid the high costs of doing business under such constraints, but this does not yet appear to be an unmistakable trend, and in each instance factors other than environmental controls or other assessments are involved, e.g., the dangers of expropriation.

In short, one cannot make a strong argument that the application or prospect of TA has yet been a major negative factor in the innovativeness of U.S. industry or even in the introduction of innovations by the government. When all industry faces the same regulatory environment, the effect on innovativeness does not appear to be major. On the other hand, it would be wrong to assert there has been no effect, especially since one would expect it to be cumulative and not to be readily detectable at the beginning of a period of tighter controls. At the moment one can only say that there are grounds neither for complacency nor excessive alarm over the effects of environmental regulations or technology assessment on the innovation process itself.

Stimulation of Innovation

As I have pointed out elsewhere, TA and regulation can be a stimulus as well as an inhibition to innovation. Auto emission standards have led to major progress in the technology of emission controls, much more than many experts anticipated. On the other hand, concentration on meeting early deadline dates for the standards has probably seriously inhibited work on new types of power plants that might meet standards at lower cost with higher reliability while reducing fuel consumption.[14]

It could well turn out that because of more rigorous standards U.S. industry will pioneer in abatement and environmental monitoring technologies and will find itself in an advantageous international position as other industrialized countries begin to adopt U.S. practices, out of imitation or necessity. This would apply both to specific abatement technologies and to environmental monitoring instrumentation, as well as to wholly new alternate manufacturing processes which are less polluting or less dangerous.

TA in the field of energy efficiency may well serve to stimulate new technologies. The energy crisis has stimulated a lot of hard scholarly thinking in this domain, previously an almost neglected topic of engineering and physics. The recent summer study of the American Physical Society (APS) on energy conservation technology is an example of this stimulus.[15] The work of OTA may also help to reorient some government research and development towards what might be termed demand-modulating rather than supply-enhancing technologies. TA may also have induced greater interest in and appreciation for the wide array of technological options available for the exploitation of solar energy.

Currently U.S. industry appears to be under greater pressure to meet environmental, energy conservation and occupational health standards than some of its foreign competitors, and in the long run this may turn out to give it a new kind of competitive edge.

Who Will Capture Assessment?

The history of regulation has been that after a while the regulated industry tends to dominate the perspective of the regulatory agency. Will this also happen eventually with EPA, OTA and other similar agencies? It seems less likely because it is not industry-specific like ICC, FPC, FCC, FDA, NRC and other regulation and assessment bodies. In the case of the older industry-specific regulatory agencies the interests of the public are diffuse and scattered, while the interests of the regulated industry are coherent and focused; hence easy to mobilize. In the newer broad agencies such as EPA almost the opposite is the case. The affected industries form a broad spectrum whose interests are too diverse to be brought together in terms of a few simple arguments, while environmental interests are increasingly well-organized and also in a position to present their case in the over-simplified terms that can garner public support. Despite this, there is evidence that as time goes on the point of view of industry tends to sink in as it is presented more consistently and persistently and with growing technical depth and sophistication to public agencies. EPA has receded from a number of recent borderline positions, at least partly under industry influence. In saying this I am not making a value judgment. EPA may have receded because in fact industry's technical arguments were more persuasive and corresponded with the conclusions of EPA's own scientists. In practice it may be very difficult to draw the line between technical persuasiveness and improper influence.

Organizations such as EPA and OTA have more incentive to develop common standards of analysis and evaluation across many different technologies. This is their great advantage over old-line regulatory agencies. It is conceivable, however, that they may be more subject to capture by particular political interest, such as environmental advocates with a strong bias against private enterprise or against economic growth.

Also, it could be argued that environmental assessment has been too much captured by the lawyers and the public health professions, who tend to view health as an absolute good not to be traded off against any economic values. This is, of course, partly a professional bias, partly a political judgment, except that treating health as an absolute is never really practical and hence results in glaring inconsistencies between standards applied to different technologies, e.g., smoking vs. mercury in swordfish, auto accidents vs. radiation safety, auto emissions vs. stationary source emissions. More recently there has been a trend

towards modulation of absolute positions on safety and the admission of economic costs as a legitimate consideration in the setting of standards.

Conversely, OTA could become the sounding board for technological promoters, the advocates of government funding for particular technologies not viewed with sufficient favor by executive agencies.

Health of Science

This was discussed at length in my Science article, "Are Scientists Obsolete?", of November 1974.[16] There is no question that TA has provided a new and fascinating domain for scientists and engineers, and a role that enhances the relative importance of science politically. TA is bound to reveal the glaring lack of basic knowledge in many areas which are of vital importance to assessment, and also increasingly to demonstrate the inefficiency of filling the gaps in an ad hoc way for each new assessment as it comes along.

TA has also given many scientists a taste of a more holistic approach to problems. Witness the work of the APS groups on energy conservation and reactor safety.[17] It has helped many academic scientists better understand the relevance of their own disciplines to national issues, and this may be a healthy thing for science in the long run. TA may prove to be for this generation of scientists what the war effort was for my generation--especially if TA is viewed in its full scope of identifying new technological possibilities as well as side effects.

NOTES

1. James Q. Wilson, "The Rise of the Bureaucratic State," The Public Interest, no. 41 (Fall 1965): 77-103.

2. See Frederick R. Anderson, NEPA in the Courts: A Legal Analysis of the National Environmental Policy Act (Baltimore and London: Johns Hopkins University Press, 1973). Appendix A, pp. 294-295, carries the exact reference cited here. United States Code Section 102 corresponds to 42 U.S.C. 4332.

3. U.S. Congress, House of Representatives, Report No. 92-1436, 92:2, Technology Assessment Act of 1972, PL-92-484, 86 Stat. 797 (1972), 25 September 1972.

4. NEPA explicitly calls for consideration of alternatives to proposed actions in the Environmental Impact Statement specified in Section 102 (see Note No. 2).

5. A.S. Weinstein et al., "Product Liability: An Interaction of Law and Technology," Duquesne Law Review 12, no. 3 (Carnegie-Mellon University, Spring 1974).

6. Peter Drucker, "New Technology: Predicting Its Impact is Perilous and Futile," New York Times, 8 April 1973, pp. 1,4.

7. Harvey Brooks, "Expertise and Politics: Problems and Tensions," Proceedings of the American Philosophical Society 119, no. 4 (15 August 1975): 257-261.

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14. H.D. Jacoby et al., Clearing the Air: Federal Policy on Automotive Emissions Control (Cambridge, Ma.: Ballinger Publishing Co., 1973).

15. Efficient Use of Energy, 3 vols., Proceedings of the American Institute of Physics Conference, The American Physical Society Studies on the More Efficient Use of Energy (New York: American Institute of Physics, 1975).

16. Harvey Brooks, "Are Scientists Obsolete?", Science 186, 8 November 1974: 501-508.

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on Science and Astronautics, U.S. House of Representatives, (Washington, D.C.: United States Government Printing Office, July 1969).

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3. Francois Hetman, Society and the Assessment of Technology (Paris: OECD, 1973).

4. John Ziman, Public Knowledge: The Social Dimension of Science (Cambridge: University Press, 1968).

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8. Arthur W. Murphy, "NEPA and the Licensing Process: Environmentalist Magna Carta or Agency Coup de Grace?", Columbia Law Review 72, no. 6 (October 1972): 963-1007.

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10. Joshua Lederberg, "The Freedoms and the Control of Science: Notes from the Ivory Tower," Southern California Law Review 45, no. 2 (Spring 1972): 596-615.

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Arnstein, Sherry, and Alexander Christakis. Perspectives on Technology Assessment. Jerusalem, Israel: Science and Technology Publishers, 1975; distributed by Crofton Publishing Corp., P.O.B. 28, Newton, Ma. 02168.

Includes the texts of papers, informal presentations and discussions at a 1974 workshop on technology assessment sponsored by the Academy for Contemporary Problems and the National Science Foundation. The book documents "lessons learned" and "problems encountered" by practitioners of TA in order to "contribute to the improvement of the state of the art."

Bevan, William. "The Sound of the Wind That's Blowing." American Psychologist 31, no. 7, July 1976: 481-491.

This essay addresses the need for a better public understanding of science and calls on the scientific community, particularly the behavioral science sector, to take an active role in meeting the need. It identifies some of the consequences of a failure to understand science and technology fully that affect political and social decisions, and calls for specific reforms, both in the education of scientists and in the education of students in general about science.

Blanpied, William, and Betsy Kwako, eds. Transdisciplinary Studies in Science and Values. 1776 Massachusetts Ave., N.W., Washington, D.C. 20036: American Association for the Advancement of Science, 1976.

This volume contains papers presented at a symposium at the 1976 annual meeting of the AAAS. Contents include: "The Cultural and Operational Distinctions between Science and Technology," by Melvin Kranzberg; "Some Reflections on Science and Society," by Harry Boardman; "Cultural Distinctions between Eastern and Western Science--Report on an Interdisciplinary Cross-Cultural Research Project," by John M. Koller; "On the Conceptualization and Measurement of Institutional Values: With Special Reference to the Values of Science," by Milton Rokeach; "Human Values and Progress in Medicine: Problems and Opportunities," by Kenneth F. Schaffner; "The Natural Sciences and the Study of Human Behavior," by Peter Buck; "Freedom and Coercion: Public Interest Science and the Reduction of Societal Options," by Philip Bereano; "Imposing Food Science and Technology: The Case of South Asia and North America," by Robert S. Anderson.

Boffey, Philip M. "Experiment Planned to Test Feasibility of a 'Science Court.'" Science 193, 9 July 1976: 129.

Plans are being made to test the value of a "science court" to help resolve controversial technical issues in which the basic facts are disputed.

Boffey, Philip M. "Grant Applications: Panel Finds New Laws Enable Stealing of Ideas." Science 193, 23 July 1976: 301-303.

The President's Biomedical Research Panel conducted a questionnaire survey of persons who had requested disclosure of information from grant and contract applications to agencies of HEW in 1975. In their report, Disclosure of Research Information (U.S. Department of Health, Education and Welfare Publication No. (OS) 76-513, submitted to the House Committee on Labor and Public Welfare, 30 June 1976), the Panel claims there is evidence that the Freedom of Information Act and various court rulings have made it possible for researchers to take ideas from grant applications of their rivals.

Boffey, Philip M. "International Biological Program: Was It Worth the Cost and Effort?" Science 193, 3 September 1976: 866-868.

For a seven-year period ending in 1974, the U.S. participated in the International Biological Program (IBP), an ambitious research effort supported by $57 million in federal grants plus substantial contributions from other organizations. This article reviews the report of an evaluation committee, appointed by the National Academy of Sciences, to examine the organization and management of the American IBP effort. (The committee's 81-page report, An Evaluation of the International Biological Program, is available from the National Technical Information Service, Springfield, Va. 22161; PB 253 158; $5.00 paper, $2.25 microfiche.)

Boffey, Philip M. "NSF: Kennedy Pours Trouble on Oiled Waters." Science 193, 10 September 1976: 986-988.

A National Science Foundation grant to an energy policy analyst who is also receiving support from the oil industry has touched off a dispute between the Foundation and the office of Senator Edward Kennedy.

Braun, Ernest; David Collingridge, and Kate Hinton. Decisions on Technology. SISCON. Leeds, England LS2 9JT: University of Leeds, 1976.

This reader, part of the series prepared by the SISCON (Science in a Social Context) project, consists of a number of case studies illustrating aspects of technological decision-making. The collection concentrates on cases in which the negative effects are thought to have dominated the gains.

Broudy, H.S. "Science, Technology and the Diminished Mind." Journal of College Science Teaching V, May 1976: 292-296.

An inquiry into a "paradoxical thesis:" "that a society successfully embodying the scientific mentality of technology can by its very success diminish the mind."

Carter, Luther. "Nuclear Initiative: Californians Vote 'No,' but Legislature Acts." Science 192, 25 June 1976: 1317-1319.

In a June 8, 1976 referendum, Californians rejected, by a two-to-one majority, an initiative that would have severely curbed the development of nuclear power in that state. But the California legislature has passed

three bills, signed by the governor, establishing important new conditions that will have to be met before any more nuclear power plants are built in the state.

Clutterbuck, C., and Simon Stander, eds. Health Hazards in Industry. SISCON. Leeds, England LS2 9JT: University of Leeds, 1976.

Another in the series of SISCON (Science in a Social Context) readers, this unit outlines some of the problems associated with identifying industrial disease in modern industry and assessing some of the technological, moral, medical, sociological and political issues involved.

Cournand, Andre, and Michael Meyer. "The Scientist's Code." Minerva 14, Spring 1976: 79-96.

The authors review the characteristic "norms" of scientific activity, assess the stresses to which the scientific code is currently being subjected, and suggest ways in which the code might be advantageously revised.

Crosland, Maurice. "Science and the Franco-Prussian War." Social Studies of Science 6, May 1976: 185-214.

This essay presents a case study of the relation between science and war. Crosland examines both the influence of war conditions on the local development of science and the influence of scientific knowledge on the outcome of war.

Culliton, Barbara J. "Biomedical Training: Time for a Slowdown." Science 193, 27 August 1976: 747-748.

A review of the first report of the Committee on a Study of National Needs for Biomedical and Behavioral Research Personnel. Created by the National Research Act of 1974, the Committee has recommended a "modest but significant" reduction of federal support of students in the basic biomedical sciences and a "significant reorientation" of government sponsorship of training of individuals in the behavioral sciences.

Culliton, Barbara J. "Confidentiality: Court Declares Researcher Can Protect Sources." Science 193, 6 August 1976: 467-469.

A California court has ruled that an academic researcher has the same right to protect confidential sources of information as does a journalist. In denying a motion to force Harvard Professor Marc J. Roberts to turn over notes from confidential interviews, Judge Charles B. Renfrew of the U.S. District Court wrote: "Compelled disclosure of confidential information would without question severely stifle research into questions of public policy, the very subjects in which the public interest is greatest." Details of the case are reviewed in this article.

Culliton, Barbara J. "Kennedy Hearings: Year-Long Probe of Biomedical Research Begins." Science 193, 2 July 1976: 32-34.

The Senate Health Subcommittee, chaired by Senator Edward M. Kennedy, has

begun a year-long review of policy in the areas of biomedical and behavioral research. Issues to be examined and some of the initial hearings are discussed in this article.

Culliton, Barbara J. "Recombinant DNA". Cambridge City Council Votes Moratorium." Science 193, 23 July 1976: 300-301.

The City Council of Cambridge, Ma., has held hearings on the safety of recombinant DNA research and on 7 July voted to declare a three-month moratorium on the work. It also voted to establish a permanent body of scientists and citizens to investigate recombinant DNA research and report back with a recommendation about allowing it to take place in Cambridge. Culliton discusses the events which led to this exercise of "public participation in science."

DeBakey, Lois. "Ethically Questionable Data: Publish or Reject?" Clinical Research 22, April 1974: 113-121.

Much attention has been given to the ethics of experimentation, but relatively little to the propriety of publication of the resulting data. This article delineates some of the problems raised by the publication of reports on human experimentation and points to the implications of editorial decisions for science and society.

DeBakey, Lois, and S. DeBakey. "Ethics and Etiquette in Biomedical Communication." Perspectives in Biology and Medicine 18, no. 4, Summer 1975: 522-540.

"Since the biomedical report, as the permanent record of the results, is an integral part of laboratory and clinical experimentation, the ethics of biomedical communication is interwoven with the ethics of biomedical science." This article focuses on the ethical responsibilities of scientist-authors, with a brief discussion of the duties of science reporters.

Drath, L., M. Gibbons, and J. Ronayne. "The European Molecular Biology Organization: A Case-Study of Decision-Making in Science Policy." Research Policy 4, 1975: 56-78.

Decisions about how resources are allocated to scientific projects constitute an important part of the data base for the formulation of scientific policy. This paper describes how, from the point of view of the British system of science, the decision was taken to join the European Molecular Biology Conference.

Engelhardt, H. Tristram, Jr. "The Roots of Science and Ethics." Hastings Center Report 6, no. 3, June 1976: 35-38.

This article gives an overview of the discussions of a research group at the Institute of Society, Ethics and the Life Sciences, that has been addressing the theme, "The Foundations of Ethics and Its Relationship to the Sciences."

Frankel, Charles, ed. Controversies and Decisions. The Social Sciences and Public Policy. New York: Russell Sage Foundation, 1976.

The essays in this volume, prepared under the auspices of the American Academy of Arts and Sciences, examine the logical, historical and institutional aspects of questions concerning the independence of the social sciences: How justified are the social sciences' claims to objectivity? Are those sciences merely disguised ideologies? What is the proper relationship between the social sciences and public policy? What are the norms of conduct for the social scientist in political controversy? What is the effect of certain institutional arrangements on the autonomy of the social sciences?

Contents include: "The Autonomy of the Social Sciences," by Charles Frankel; "The Role of Values in Social Science Research," by Nicholas Rescher; "The Reward System of the Social Sciences," by Jonathon R. Cole and Stephen Cole; "The Ideal of Objectivity Among American Social Scientists in the Era of Professionalization, 1876-1916," by Hugh Hawkins; "Max Weber and the Roots of Academic Freedom," by Robert Nisbet; "Five Decades of Public Controversy Over Mental Testing," by Lee J. Cronbach; "The Jensen Controversy: A Study in the Ethics and Politics of Knowledge in a Democracy," by Yaron Ezrahi; "Scholars as Public Adversaries: The Case of Economics," by Harry G. Johnson; "Science Advising and the ABM Debate," by Paul Doty; "Scholarly Rights and Political Morality," by Kenneth D. Boulding; "Federal-Academic Relations in Social Science Research," by H. Field Haviland; "The Federal Government and the Autonomy of Scholarship," by Harvey Brooks; "How Good Was the Answer? How Good Was the Question?" by Adam Yarmolinsky; "Legitimating the Social Sciences: Meeting the Challenges to Objectivity and Integrity," by Edward Shils.

Frazier, Kendrick. "Science and the Parascience Cults." Science News 109, 29 May 1976: 346-350.

Concerned about the growing public interest in psychic phenomena, the occult and pseudoscience, about 40 scholars, scientists and researchers have organized the "Committee to Scientifically Investigate Claims of the Paranormal." This article describes the formation of the group and its proposed functions.

The article provoked considerable reader response. For a sample of letters, see: "Science and Pseudoscience: Response." Science News 109, 19 June 1976: 397-399.

Greenberg, Daniel S. "Major Battle Looms in Congress over Support for Basic Research." The Chronicle of Higher Education, 21 June 1976: 9.

A report of the House Appropriations Committee contends that the scientific community is exaggerating its financial needs. Although a Senate subcommittee backed the Administration's request for an increase in NSF's FY1977 funds, the House Committee rejected the argument that basic research has been undersupported.

Greenberg, Daniel S. "Senate Likely to Pay for Proxmire Defense." The Chronicle of Higher Education, 31 May 1976: 11.

Senator William Proxmire initiated the "Golden Fleece Award" in 1975 to spotlight alleged wastefulness by federal agencies. Now a researcher is suing the Senator, charging that he was libeled when the "Award" was bestowed on three federal agencies that supported his research.

Holden, Constance. "If I Were the Science Adviser: Some Luminaries Have Their Say." Science 193, 6 August 1976: 464-467.

The selection of H. Guyford Stever as the President's science adviser was announced just as Science was completing a survey to find out what various people would do if appointed to that position. This article reports the views of: Barry Commoner, William O. Baker, Alvin Weinberg, Jeremy Stone, Lester Brown, B.F. Skinner, Amitai Etzioni, Garrett Hardin, Margaret Mead; Theodore Roszak, Arthur Kornberg, Dixy Lee Ray, Willard Libby and Bruce Murray.

Hollinger, David A. Morris R. Cohen and the Scientific Ideal. Cambridge, Ma.: MIT Press, 1975.

Cohen was one of the early twentieth century's most influential commentators on the cultural significance of the "scientific method." This critical study of his career analyzes Cohen's science-based philosophy and explores the function of that philosophy in the learned discourse of the U.S. from about 1915 to 1945.

Jonas, Hans. "Freedom of Scientific Inquiry and the Public Interest." Hastings Center Report, August 1976: 15-17.

Jonas takes a probing look at the premise that scientific inquiry per se raises no moral problems. He argues that "moral and legal issues arise in the inner workings of science, long before the question of application arises," and thus that "the ancient alibi of pure theory and with it the moral immunity that it provided no longer hold."

See also "Inquiring into Inquiry: Two Opposing Views." Hastings Center Report, August 1976: 18-19, for responses to Jonas by Robert Sinsheimer and Gerard Piel.

Lawrence, Eleanor. "Genetic Manipulation: Guidelines Out." Nature 263, 2 September 1976: 4-5.

Discusses the report on genetic manipulation experiments involving recombinant DNA prepared in Great Britain by the Working Party on Genetic Manipulation. This is the counterpart to the set of guidelines issued recently in the U.S. by the National Institutes of Health.

Marx, Jean L. "Science and the Press: Communicating with the Public." Science 193, 9 July 1976: 136.

On May 3-6, 1976, the Society for Neuroscience sponsored a seminar for scientists and science writers to discuss some of the problems involved in communicating

science to the general public. The existence of the seminar is but one indication of the growing acknowledgement that the press is a useful tool for educating the public about scientific research.

National Science Foundation. 1985 R & D Projections. (Available for purchase from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $0.75 per copy. Stock number is 038-000-00-292-9.)

This report presents estimates of R & D spending in 1985. Projections are derived from statistical studies of past relationships between R & D funding and other economic variables and analyses of current economic conditions and trends. The report states that the "projected numerical figures should be regarded with caution and should certainly not be considered as precise indicators."

National Science Foundation. Expenditures for Scientific and Engineering Activities at Universities and Colleges, Fiscal Year 1974. (Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, at $1.15 per copy. Request stock no. 038-000-00270-8.)

Contains statistical data on scientific expenditures--research, development and instruction in the sciences and engineering--by U.S. universities and colleges for fiscal year 1974.

National Science Foundation. Federal Support to Universities, Colleges and Selected Nonprofit Institutions, Fiscal Year 1974. (Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $1.80 per copy. The stock no. is 038-000-00276-7.)

Includes data on the size and characteristics of federally supported activities in the university and college sector. The report focuses on the $2.7 billion obligated for academic science activities, including research and development, R & D facilities, fellowships and training grants, general support for science, and facilities and equipment for instruction in the sciences and engineering.

National Science Foundation. Graduate Science Education: Student Support and Postdoctorals, Fall 1974 (NSF 76-313) (Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, at $2.10 per copy. The stock number is 038-000-00-289-9.)

Presents detailed analyses of results of a 1974 nation-wide survey of enrolment of graduate science and engineering students in Ph.D.-granting institutions and sources of their financial support. Provides data on full- and part-time enrolment, level of study, citizenship, sex of student, control of institution and distribution among fields of science. Data on postdoctoral utilization are available in terms of field of science and source of support.

National Science Foundation. Manpower Resources for Scientific Activities at Universities and Colleges, January 1975. (Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, at $1.45 per copy. Stock no.: 038-000-00-287-2.

Prepared by NSF's Division of Science Resources Studies, this report presents the results of an NSF survey of scientific and engineering personnel employed at universities and colleges, taken in January 1975.

National Science Foundation. National Patterns of R & D Resources: Funds & Manpower in the United States, 1953-1976. (Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 at $0.95 per copy. Stock no.: 038-000-00285-6.)

The report covers R & D funding and manpower in the four sectors of the economy: the Federal Government, industry, universities and colleges, and nonprofit institutions.

National Science Foundation. Science Resources Studies Highlights, "Academic Spending Up Twelve Percent in FY 1975." (Copies of the report, NSF 76-307, are available upon request from the Division of Science Resources Studies, National Science Foundation, 1800 G St., N.W., Washington, D.C. 20550.)

Presents data on research and development expenditures at U.S. universities and colleges in fiscal year 1975.

Nelkin, Dorothy. "The Science-Textbook Controversies." Scientific American 234, April 1976: 33-39.

This article explores the social and political tensions that sustain objections to the teaching of science in public schools. It suggests that three themes pervade the textbook disputes: a concern that science influences traditional moral and religious values, a resentment of the authority represented by science, and a demand that science should be more closely related to egalitarian and pluralist political values. A selection of letters concerning the article, together with an informative note by the author, appears in Scientific American 235, July 1976: 6-9.

Nichols, William. "Sceptics and Believers: The Science-Humanities Debate." The American Scholar, Summer 1976: 377-386.

This engaging essay traces the history of science-humanities debates, beginning with Thomas Carlyle's 1829 essay, "Signs of the Times," and Thomas Walker's response, "Defense of Mechanical Philosophy," in 1831, and continuing to some of the more recent exchanges.

"No Vacation for DNA Issue." Science News, 7 August 1976: 87, 90.

Recent developments concerning recombinant DNA research: the application of Stanford University and the University of California for a patent on certain recombinant techniques, and a letter from Senators Edward Kennedy and Jacob Javits to President Ford expressing concern about industry's freedom from regulation.

Norman, Colin. "Genetic Manipulation: Guidelines Issued." Nature 262, 1 July 1976: 2-4.

A report on the NIH guidelines for recombinant DNA experiments and developments indicating that the debates about the research are far from over.

Norman, Colin. "Genetic Manipulation to be Patented?" Nature 261, 24 June 1976: 624.

A patent application governing commercial uses of recombinant DNA techniques has been filed by Stanford University and the University of California. If it is awarded, the holders of the patent could insist that commercial users of the process agree to abide by NIH guidelines which are currently not binding on industry. The patent, which would not affect research uses of the technique, may provide a means of extending the coverage of the guidelines.

Norman, Colin. "Science vs. the Public." Nature 262, 15 July 1976: 163-165.

An analysis of the conflict between groups of scientists, city officials and Cambridge, Ma., residents over plans to conduct recombinant DNA research at Harvard and MIT.

Office of Technology Assessment. Office of Technology Assessment: Annual Report to the Congress. 15 March 1976. (Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, at $1.55 per copy. Stock no.: 052-003-00152-7.)

This report covers the activities of the Office of Technology Assessment during calendar year 1975. The four major sections describe the structure and organization of OTA, its operating procedures, the activities of the Advisory Council and the assessment plans and programs within OTA's seven priority areas. OTA publications, personnel and advisory panelists are listed in the appendices.

Olson, Richard. "Scientists are Losing Their Intellectual Arrogance." Psychology Today 9, January 1976: 70, 86, 90.

Olson examines Rousseau's four basic criticisms of science, considers the traditional defenses of science and their shortcomings, and turns to a discussion of the probability and nature of a reconciliation between science and its critics.

Paldy, Lester G. "The NSF Science Education Program and the Politics of Peer Review." Journal of College Science Teaching V, May 1976: 323-327.

An insightful analysis of the controversy over NSF's precollege curriculum program and its links with recent attacks on the agency's peer review process.

"Recombinant DNA Meets the Cambridge City Council." Science News 110, 17 July 1976: 36.

A description of events leading up to the Cambridge, Ma. City Council's declaration of a three-month moratorium on certain recombinant DNA experiments.

Reingold, Nathan. "Reflections on Two Hundred Years of Science in the United States." Nature 262, 1 July 1976: 9-13.

The author contends that despite avid interest in current U.S. science policies and developments, the history of American science is given inadequate attention outside of the U.S. He urges that the sciences in America be considered and examined as a set of historiographic problems.

Ronayne, J. "Australia." International Social Science Journal XXVIII, no. 1, 1976: 48-64.

This article describes the status of research policy and planning in Australia, with special attention to the circumstances which have contributed toward the situation of science and scientists in that country today. It provides an overview of administrative and policy structures in scientific research, an account of over-all science policy machinery and a discussion of participation by scientists in decision-making.

St. James-Roberts, Ian. "Are Researchers Trustworthy?" New Scientist 171, 2 September 1976: 481-483.

Except for a few well-publicized events, little is known about scientific dishonesty. "Science," claims the author, "has maintained an ostrich-like attitude about intentional bias too long." New Scientist has launched an investigation of "intentional bias" and invites readers to participate through a questionnaire in this issue.

Science Policies for the Decade Ahead. Philadelphia, Pa.: The Franklin Institute Press, 1976.

This volume contains the proceedings of The Second Franklin Conference, chaired by H. Guyford Stever. Panelists included: George Kistiakowsky, James R. Killian, Jerome Wiesner, Donald Hornig, Lee DuBridge, Edward E. David, Jr., David Z. Beckler, Harvey Brooks, and Robert B. Gilpin, Jr.

Among the discussion topics are: How Should U.S. Science Policy Be Set; Can Science Answer Our Needs; Energy Resources; Population and World Food Resources; National and International Economic Interdependence.

Scientists' Institute for Public Information. Nuclear Power, Economics and the Environment. 6052 Claremont Ave., Oakland, Ca. 94618: Scientists' Institute for Public Information. (The price is $2.00 for single issues; $1.75 a copy for ten or more.)

The articles in this reader originally appeared in Environment Magazine. Contents include: "Introduction," by Martin Brown; "Report Card on Nuclear Power," by Sheldon Novick; "Nuclear Safety," by Daniel F. Ford and Henry W. Kendall; "The Failsafe Risk," by Kurt H. Hohenemser; "An Explosive Reactor Possibility," by Kevin P. Shea; "Nuclear Misinformation," by Daniel F. Ford and Henry W. Kendall; "Fire Damage," by E.A. Martell, P.A. Golden, J.J. Kraushaar, D.W. Shea, and R.H. Williams; "Hot Wastes from Nuclear Power," by George C. Berg; "Expensive Enrichment," by Marvin Resnikoff; "A Troublesome Brew," by Sheldon Novick; "A

Poor Buy," by J.B. Cochran, J. Gustave Speth, and Arthur Tamplin.

Seagrave, Sterling. "Science Court: Test Case This Year?" BioScience 26, June 1976: 377-380.

A report on recent developments concerning the establishment of a "science court" and efforts to select a test case.

Shapley, Willis. Research and Development in the Federal Budget: FY 1977. Washington, D.C.: American Association for the Advancement of Science, 1976.

This report and commentary by a former budget official provides a concise and current picture of the federal budget and budgeting process; an explanation of how R & D appears in the federal budget; how constraints and alternatives affect decisions; a discussion of R & D budget issues; and a review of the President's budget for FY1977, and what it means for R & D.

Sills, David. "Social Science Research and the Formation of Energy Policy." Social Impact Assessment 5, May 1976: 5-10.

This paper outlines a number of areas in which social science research could usefully illuminate the formation of energy policy.

Steinfels, Peter. "Biomedical Research and the Public: A Report from the Airlie House Conference." Hastings Center Report 6, no. 3, June 1976: 21-25.

A report of a meeting held in the spring of 1976 to explore sources and remedies for tensions between biomedical research scientists and the lay public.

Task Force of the Presidential Advisory Group on Anticipated Advances in Science and Technology. "The Science Court Experiment: An Interim Report." Science 193, 20 August 1976: 653-656.

The Task Forces proposes "a series of experiments to develop adversary proceedings and test their value in resolving technical disputes over questions of scientific fact." This report presents the reflections of the Task Force on the following aspects of the proposed experimental Science Court: procedures, including issue selection, selection of advocates, judges and referees, and the adversary process; anticipated results of the proceeding; and the evaluation of the experiment.

Thackray, Arnold. "Scientific Networks in the Age of the American Revolution." Nature 262, 1 July 1976: 20-24.

Channels of communication between scientists in the U.K. and U.S. during the late eighteenth and early nineteenth centuries are reviewed in the light of the social, cultural and political moods of the time.

Tidball, M. Elizabeth, and Vera Kistiakowsky. "Baccalaureate Origins of American Scientists and Scholars." Science 193, 20 August 1976: 646-652.

This article analyzes the institutional productivity of U.S. colleges and

universities, in terms of baccalaureate recipients who have subsequently earned research doctorates. The data show that the undergraduate institutions from which women have gone on to doctorates differ from those of men.

Tribe, L., C.S. Schelling, and J. Voss, eds. When Values Conflict. Cambridge, Ma.: Ballinger, 1976.

Nine essays on the philosophy of environmental protection. The authors are members of a group sponsored by the American Academy of Arts and Sciences to study the problems of decision-making about the environment. One of the main problems is how to incorporate what the study calls "fragile" values into the "hard" values which can reasonably be quantified. (See the essay review by Eric Ashby, "Towards an Environmental Ethic," in Nature 262, 8 July 1976: 84-85.)

Wade, Nicholas. "Recombinant DNA: Chimeras Set Free under Guard." Science 193, 16 July 1976: 215-217.

A brief analysis of the final version of the guidelines for recombinant DNA research, issued by the National Institutes of Health at the end of June after two years of debate and discussion.

Wade, Nicholas. "Recombinant DNA at White House." Science 193, 6 August 1976: 468.

In a July 19 letter to President Ford, Senators Edward Kennedy and Jacob Javits urge him to make all recombinant DNA research, including that conducted by industry, subject to federal control. Because the NIH guidelines issued in June apply only to NIH grantees, the Senators are concerned that much recombinant DNA research would not be subject to any control.

Walsh, John. "British Science Policy: Assuming a Lower Profile." Science 193, 9 July 1976: 132-134.

Shortly after the resignation of Harold Wilson from the Office of Prime Minister, the British Government reorganized its procedures for providing science advice at high levels, and abolished the office of Science Adviser to the Government. Events leading to these steps are described in this article.

Walsh, John. "Nuclear Power: France Forges Ahead on Ambitious Plan Despite Critics." Science 193, 23 July 1976: 305-306, 340.

This article discusses the development and current state of antinuclear activism in France.

Walsh, John. "Science Adviser: Four GOP Senators Seek to Block Nomination of Stever." Science 193, 2 July 1976: 35-37.

Objections to NSF policies and procedures led four Senators to urge President Ford not to appoint NSF director Guy Stever as head of the White House science office.

Weart, Spencer R. "The Rise of 'Prostituted' Physics," Nature 262, 1 July 1976: 13-17.

The influence of science on business and industry has grown dramatically in the twentieth century. This article charts the rise of industrial research and its sustained vigor during this period.

Ziman, John. The Force of Knowledge. Cambridge, England: Cambridge University Press, 1976.

Subtitled "The Scientific Dimension of Society," this book extends the author's previous work (Public Knowledge) on the relations between science and society. Here he examines the historical development of scientific research as a profession, the growth of scientific technologies out of the useful arts, the sources of invention and technical innovation, and the advent of Big Science. Among current problems, Ziman discusses the economics of research and development, the connections between science and war, the nature of science policy, and the moral dilemmas of social responsibility in science. The final section includes a chapter-by-chapter list of suggested topics for oral and written discussion, with limited references to pertinent materials.

Zinberg, Dorothy. "Education through Science: The Early Stages of Career Development in Chemistry." Social Studies of Science 6, May 1976: 215-246.

This paper presents the findings of a five-year study of the career development of a group of chemistry students in a British university. Begun in 1968, "the study attempted to identify significant social-psychological themes and environmental factors that contributed to the students' perceptions of their undergraduate experience--and, in turn, the cumulative effect of these experiences on the development of their postgraduate career plans."